PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : G07F 9/02 — A1

(11) International Publication Number: **WO 99/48065**

(43) International Publication Date: 23 September 1999 (23.09.99)

(21) International Application Number: PCT/US99/05983

(22) International Filing Date: 18 March 1999 (18.03.99)

(30) Priority Data:
60/078,645 — 19 March 1998 (19.03.98) — US
60/099,434 — 8 September 1998 (08.09.98) — US

(71) Applicant: ISOCHRON DATA CORPORATION [US/US]; Suite 2470, 3925 West Braker Lane, Austin, TX 78759 (US).

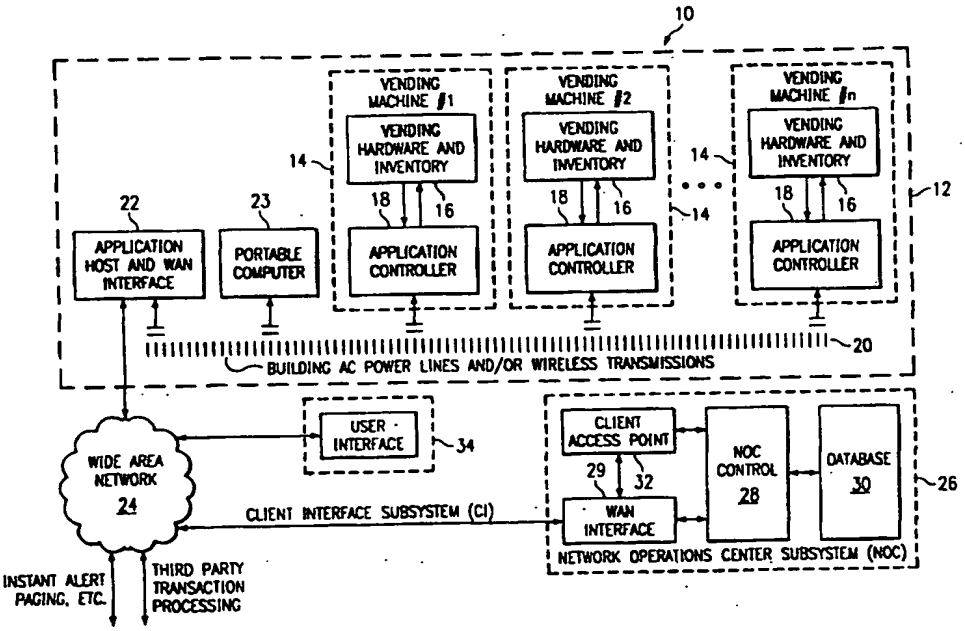
(72) Inventor: DEFOSSE, Erin, M.; 3607 Greystone Drive #1716, Austin, TX 78731 (US).

(74) Agent: FELGER, Thomas, R.; Baker & Botts, L.L.P., 2001 Ross Avenue, Dallas, TX 75201-2980 (US).

(81) Designated States: AE, AL, AM, AT, AT (Utility model), AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), EE, EE (Utility model), ES, FI, FI (Utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (Utility model), SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: REMOTE DATA ACQUISITION AND TRANSMISSION SYSTEM AND METHOD



(57) Abstract

A remote data acquisition and transmission system and method are disclosed. A plurality of application controllers are interfaced with remote equipment from which operation data is acquired by the application controllers. The application controllers communicate with an application host via a local area network, and the application host can communicate with a network operations center using a wide area network interface. In one embodiment, each application controller interfaces with remote equipment that comprises a vending machine.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece			TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	NZ	New Zealand		
CM	Cameroon			PL	Poland		
CN	China	KR	Republic of Korea	PT	Portugal		
CU	Cuba	KZ	Kazakstan	RO	Romania		
CZ	Czech Republic	LC	Saint Lucia	RU	Russian Federation		
DE	Germany	LI	Liechtenstein	SD	Sudan		
DK	Denmark	LK	Sri Lanka	SE	Sweden		
EE	Estonia	LR	Liberia	SG	Singapore		

REMOTE DATA ACQUISITION AND TRANSMISSION SYSTEM AND METHOD

TECHNICAL FIELD OF THE INVENTION

The present invention relates in general to the field of remote data acquisition. More particularly, the present invention relates to a remote data acquisition and transmission system and method and, specifically, such a system for monitoring and control of vending machines.

BACKGROUND OF THE INVENTION

Over the past decade, vending machine manufacturers have developed new and innovative vending equipment in response to market needs and vending operator demands. These innovations have been, for the most part, adopted by the beverage vending industry. This trend has been influenced by the accelerating rate of technological innovation in the electronic and electro-mechanical component industry. The availability of new technologies has given vending machine manufacturers the tools to address many of the requirements of vending operators. Advances in electronics are now enabling the use of computer controls and data acquisition systems directly inside the vending machine. Some of the latest vending machines now make it possible for vending machine operators to download sales, inventory, and machine health information on-site onto portable computers.

Although these computerized systems make it easier for operators to gather and analyze data, they generally

do not provide the real time capabilities that are needed to make a major impact on their vending operations.

There currently exist some remote data capture systems in the vending industry. Examples of such systems include the systems disclosed in U.S. Patent Nos. 5,608,643; 4,766,548 and 4,412,292. Most of the conventional systems make use of point-to-point data acquisition systems that use a wireless data transmission system to receive and send information from/to individual vending machines. Some of the systems use wire-line data transmission systems (e.g. telephone lines) instead of a wireless one. The wireless point-to-point systems are hampered by the relatively high cost of long-range wireless transceivers at each of the vending machines. Further, the systems that implement long-range wireless transceivers at each vending machine have a severe limitation in that they cannot be made to function properly in locations that do not have a clear RF path to the central base station outside the building, perhaps even miles away. For example, if a vending machine is located deep inside a building the ability to transmit/receive data to/from the outside of the building is hampered by the signal attenuation caused by the building's structure. On the other hand, the wire-line systems suffer from high infrastructure costs given that dedicated wire must be drawn to each vending machine in order to create the point-to-point data link. Establishing a wire-line system is often a difficult task and frequently limits the ability to move associated vending machines from one location to another location. Thus, these conventional remote data capture systems generally do not adequately fill the needs of vending machine operators.

SUMMARY OF THE INVENTION

In accordance with the present invention, a remote data acquisition and transmission system is disclosed that provides advantages over previously developed remote data acquisition systems. In one embodiment, the remote data acquisition and transmission system is for monitoring and control of vending machines. The remote data acquisition and transmission system allows vending machine operators to gather data from the field without having to manually retrieve the data from the vending equipment and to transmit data to the field such as price changes without having to visit each vending machine. This ability will generally lead directly to improved sales and lower operational costs by enhancing a manager's ability to direct operations and react quickly in order to correct problems.

According to one aspect of the present invention, the system comprises one or more application controllers and an application host. The application controller or controllers are interfaced with remote equipment from which operation data may be acquired and information transmitted thereto by each application controller. Each application controller communicates with an application host via a local area network, and the application host can communicate with a network operations center using a wide area network interface. The system may include a local area network (LAN) with one unit and its associated application host or multiple units and associated application hosts.

According to another aspect of the present invention, a remote data acquisition and transmission system is provided for vending machines. This system

comprises a plurality of application controllers. Each application controller interfaces, via a serial interface to a vending machine controller, with a vending machine from which operation data is acquired by the application controller. The system may also comprise an application host that communicates with the application controllers via a local area network. The application host comprises a wide area network interface for communicating with a network operations center. The network operations center communicates with the application host via a wide area network to receive the operation data acquired by the application controllers and to manage outgoing messages and/or data. Further, the application controllers and the application host operate to autoconfigure the local area network upon initialization, and the application controllers operate as relays when necessary to establish communication between the application host and other application controllers. In addition, the network operation center maintains a database storing the operation data and providing secure third party access to the database.

According to a further aspect of the present invention, a method is provided for remote data acquisition and transmission. The method includes interfacing a plurality of application controllers with remote equipment from which operation data is acquired by the application controllers. The method further includes communicating between an application host and the application controllers via a local area network, and communicating between the application host and a network operations center using a wide area network interface. Technical advantages of this embodiment of the present invention include the use of local wire-line and/or

local-area wireless transmissions to implement a local area network (LAN) between multiple vending machines. This provides a remote data acquisition system for vending machines that overcomes the limitations of current point-to-point systems by establishing a low-cost LAN that can then communicate externally using a long-range wireless or wire-line communication system. For example, a narrowband PCS wireless link (e.g., wireless two-way paging network) can be used between a remote vending machine LAN and a network operations center to establish an efficient and low-cost wide area network (WAN) which connects remote LANs together to form a larger network.

Additional technical advantages should be readily apparent from the drawings and description.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete understanding of the present invention and advantages thereof may be acquired by referring to the following description taken in conjunction with the accompanying drawings, in which like reference numbers indicate like features, and wherein:

FIGURE 1 is a functional block diagram of one embodiment of a remote data acquisition system for vending machines according to the present invention;

FIGURE 2 is a functional block diagram of one embodiment of an application controller and its interface with vending hardware according to the present invention;

FIGURE 3 is a functional block diagram of one embodiment of an application host according to the present invention;

FIGURE 4 is a functional block diagram of one embodiment of a network operations center according to the present invention;

FIGURE 5 is a functional block diagram of one embodiment of a client WAN interface according to the present invention; and

FIGURE 6 is a functional block diagram of one embodiment of a wireless local area network implementation architecture according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The preferred embodiment of the present invention and its advantages are best understood by referring to FIGURES 1-6 of the drawings, like numerals being used for like and corresponding parts of the various drawings.

FIGURE 1 is a functional block diagram of one embodiment of a remote data acquisition system for vending machines, indicated generally at 10, according to the present invention. In general, system 10 of FIGURE 1 communicates information from a vending site 12 externally over a wide area wireless or wire-line network and internally over a local area wireless or wire-line network. As shown, the local area network at vending site 12 can be referred to as a vendor interrogation LAN subsystem (VIL). Vending site 12 may include only one vending machine 14 or a plurality of vending machines 14. Each vending machine 14 may include vending hardware and inventory 16 for performing vending functions and electronically tracking some vending information. Vending machines 14 may provide various types of products to customers such as soft drinks, snacks, etc.

According to the present invention, each vending machine 14 may include an application controller 18 coupled to and interfacing with vending hardware and inventory 16. Many vending machines 14 are equipped with electronics for controlling vending operations as well as tracking some vending events such as money received, change given and number of vends from each slot. Application controllers 18 can communicate with such embedded electronics as well as be equipped to directly sense other vending events and vending equipment parameters (e.g. compressor performance). Application controllers 18 can also communicate with one another and the application host 22 via onboard wire-line interfaces or wireless transceivers using wire-line or wireless transmissions respectively.

The term "wire-line transmissions" is used to refer to all types of electromagnetic communications over wires, cables, or other types of conduits. Examples of such conduits include, but are not limited to, metal wires and cables made of copper or aluminum, fiber-optic lines, and cables constructed of other metals or composite materials satisfactory for carrying electromagnetic signals. Wire-line transmissions may be conducted in accordance with teachings of the present invention over electrical power lines, electrical power distribution systems, building electrical wiring, conventional telephone lines, T-1 lines, T-3 lines, ISDN lines, ADSL, etc.

The term "wireless transmissions" is used to refer to all types of electromagnetic communications which do not require a wire, cable, or other types of conduits. Examples of wireless transmissions for use in local area networks (LAN) include, but are not limited to, radio

frequencies, especially the 900 MHZ and 2.4 GHz bands, infra-red, and laser. Examples of wireless transmissions for use in wide area networks (WAN) include, but are not limited to, narrowband personal communications services (PCS), broadband PCS, circuit switched cellular, and cellular digital packet data (CDPD), etc.

Together, application controllers 18 and application host 22 form a LAN supported by the wire-line and/or wireless transmissions 20. In addition, application controllers 18 can also act as repeaters in case application host 22 cannot directly communicate with a particular application controller 18 while another application controller 18, which does have an established communication link with application host 22, can directly communicate.

Application host 22 acquires data captured by application controllers 18 and can package and communicate that data across an external network 24 using a wide area network (WAN) interface. Application host 22 can be installed together with application controller 18 inside a vending machine or housed separately in another location. In the event that the application host 22 is placed inside a vending machine together with an application controller 18, it is possible to share some of the electronic components between them, the LAN transceiver for example, in order to reduce the cost of the hardware. In this case, the application host 22 and application controller 18 inside the same vending machine, would communicate with each other over a hardwired interface between the two components. Alternatively, the application host 22 and application controller 18 can be designed to be a single integrated component within a vending machine. Furthermore, an

application host 22 can be used whose function consists of solely monitoring the application controllers 18. For example, such an application host 22 could take the form of a hand-held portable computer 23 to be carried by service or delivery personnel in order to query the application controllers 18 without having to interact via the WAN interface.

The WAN interface 22 can be implemented in one of a number of ways. In particular, WAN interface 22 is designed to support a wide area network 24 that can be implemented via wire-line or wireless transmissions. If a wireless narrowband PCS paging network is used to implement the WAN, messages from application host 22 can be communicated as digital messages through the pager network and stored in one or more dedicated message mailboxes provided by the wireless network operator. These mailboxes can be securely accessed, for example, through an Internet-based connection.

As shown in FIGURE 1, a network operations center (NOC) 26 communicates with one or more vending sites 12 across wide area network 24. As mentioned, in one implementation, network operations center 26 can access mailboxes that store message transmitted by application hosts 22 at vending sites 12. In the embodiment of FIGURE 1, network operations center 26 includes a NOC control 28 that communicates with wide area network 24 through a WAN interface 29. NOC control 28 can receive data acquired from and transmit data to vending sites 12, process the data and store the data into a database 30. NOC control 28 can also perform instant alert paging, direct dial alarms and other functions to provide real time notification to a vending operator upon the occurrence of certain events (e.g., out-of-stock, power

outage, vandalism, etc.). NOC control 28 can also provide third party transaction processing such as allowing queries on database 30. The WAN interface 29 between NOC control 28 and the wide area network 24 can be implemented through the use of either wire-line or wireless transmissions.

At network operations center 26, a client access point 32 provides access from a client interface subsystem (CI) 34 across external network 24. In one implementation, client access point 32 can be a web-based interface allowing user access from a client computer across a network such as the Internet. Other implementations include providing a direct-dial connection between client interface subsystem 34 and client access point 32. Once connected, a user can use client interface subsystem 34 to obtain information from database 30 based upon data acquired from vending sites 12. Further, users can be provided with extended services such as trend information developed by mining and analyzing database 30.

According to the present invention, system 10 of FIGURE 1 combines a number of technologies to provide technical advantages in the area of vending machine management and to overcome existing problems with conventional remote data acquisition systems for vending machines. As mentioned above, some conventional remote data acquisition systems employ a point-to-point wireless communication link to retrieve information from and send information to a plurality of remote devices. Further, wide-area networks (WAN) are often formed from a plurality of local area networks (LANs), and such LANs are often interconnected using a wire-line or wireless data transmission system. In other technical areas,

wire-line and wireless transceivers have been used for local area network communication. For example, power line networks are used in a variety of applications such as in the implementation of "smart building" functions, including the systems disclosed in U.S. Patent Nos. 3,976,264 and 4,763,104. Yet wire-line and wireless LAN communications have generally not been implemented for purposes of data acquisition or vending machine management. In particular, conventional vending machine management systems do not use wire-line and/or wireless transceivers for local interconnection of data acquisition and control devices as does system 10 of FIGURE 1.

FIGURE 2 is a functional block diagram of one embodiment of the interface between application controller 18 and vending hardware and inventory 16 according to the present invention. In general, application controller 18 interfaces to the internal systems of vending machine to perform data acquisition and control functions and to provide a wire-line and/or wireless data communication transceiver for establishing a communication link with application host 22 (FIG. 1). As shown, vending hardware 16 can include electro-mechanical components 50, some of which are coupled to and interface with a vending machine controller (VMC) 54.

Application controller 18 interfaces with vending hardware 16. As shown, this interface can include a serial interface 56 (e.g., Multi-Drop Bus or DEX Port) that communicates with VMC 54 using a standard data protocol (e.g. DEX/UCS) implemented by many conventional vending machines. The interface can also include direct sensing of components 50 using digital sensors 58 and analog sensors 60. Analog sensors 60 can be coupled to

analog-to-digital (A/D) converters 62 to convert analog measurements to digital signals. A central microprocessor or microcontroller 64 can be coupled to and interface with serial interface 56, digital sensors 58 and A/D converters 62 to acquire data relating to the operation of vending hardware 16. Application controller 18 also can include RFID transceiver device 65 that can directly scan inventory 16 in order to obtain inventory readings. For example, RFID 65 could generate a radio signal that is received by passive transponders attached to inventory items. These transponders can then reply with unique identifiers to the application controller 18 to determine exact inventory levels.

Microprocessor 64 can communicate inventory, event and other data using a wire-line or wireless LAN transceiver 66 that sends the data via wire-line or wireless transmissions respectively. As discussed above, microprocessor 64 can transmit/receive data to/from an application host located at the vending site or to/from a hand-held portable computer acting as an application host. Microprocessor 64 can also communicate with an electronic lock driver 69 which interfaces with an electronic lock 71. In the event that an application controller is collocated with an application host within a vending machine, then the two can communicate using a hardware interface bus 67 which allows the two devices to share electronic components, for example, the LAN transceiver 66.

Further, as shown, application controller 18 may include various types of memory units such as random access and read-only memory (RAM/ROM) 70, FLASH memory and/or Electrically Erasable/Programmable read-only-memory (Flash memory/EEPROM) 72 for storing application

code and vending data. The Flash memory can be remotely programmed using the LAN and/or the WAN in the event that its data becomes corrupted or requires upgrade. The present invention is not limited to any specific type of memory unit. Further, application controller 18 may include a power supply 68, a backup battery 74 as well as a heater 76 (if needed).

FIGURE 3 is a functional block diagram of one embodiment of application host 22 according to the present invention. In general, application host 22 can communicate with application controllers 18 and can communicate externally to establish a link with a remote computer, thus enabling the formation of the WAN. In the embodiment of FIGURE 3, application host 22 includes a microprocessor 80 that communicates with application controllers 18 using a LAN transceiver 82. This communication, for example, can involve wire-line and/or wireless transmissions depending upon the operating characteristics of LAN transceiver 82. Application host 22 can also communicate with an application controller 18 using a hardware interface bus 84. For example, this connection can be used in the case where application host 22 is collocated inside a vending machine together with an application controller.

Microprocessor 80 can receive data captured by application controllers 18, process the data and store the data in a mass storage device 86 (e.g., hard drive, solid-state recorder, FLASH memory). Microprocessor 80 can then retrieve data from storage device 86 and communicate data externally using a WAN wireless transceiver 92 or WAN wire-line interface 94 communicating via wireless or wire-line transmissions respectively. In particular, wireless transceiver 92 can

be used to implement a digital paging network based communication scheme across a narrowband PCS network as mentioned above. Application host 22 can also include random access and read-only memory (RAM/ROM) 96 and/or FLASH memory 98 for storing application code and vending data. The Flash memory can be remotely programmed using the WAN in the event that its data becomes corrupted or requires upgrade. The present invention is not limited to any specific type of memory unit. Further, application host 22 can include a power supply 104, a back-up power source 100 (e.g., battery) as well as a heater 102 (if needed). Some of the components of application host 22 may be unnecessary if application host 22 and an application controller 18 are interfaced directly inside a vending machine.

FIGURE 4 is a functional block diagram of one embodiment of network operations center 26 according to the present invention. As shown, network interface 29 can include various interface devices such as a WAN wire-line interface 110 or WAN wireless transceiver 112 communicating via wire-line or wireless transmissions respectively. These interface devices support connections to external network 24 and communicate internally with a network abstraction and data routing unit 116. Unit 116 can route data to NOC control 28 or client access point 32 as appropriate. NOC control 28 can include one or more device monitoring and control units 118 and transaction servers 119 that have access to a NOC database 30. Database 30 can include a database query brokerage engine 120 connected to a DBMS 122. Client access point 32 can include a client access server 124 that also has access to database 30 through transaction server 119. Transaction servers 119 can

operate to receive data acquired from remote vending machines, store and maintain data in database 30, and provide access to database 30. Client access point 32 can operate to support client access to network operations center 26 and database 30.

FIGURE 5 is a functional block diagram of one embodiment of the client interface 34 according to the present invention. As shown, client interface 34 can include a WAN interface 130, a user terminal 132 and a database 134. WAN interface 130 can have a number of interface devices for supporting connections to the wide area network 24. These may include a WAN wire-line interface 136 or WAN wireless transceiver 138 communicating via wire-line or wireless transmissions respectively. Network interface 130 is connected to user terminal computer 132 via a network abstraction and data routing unit 140. User terminal 132 can include a user applications and database middleware 142 and a graphical user interface 143. User terminal 132 can also be connected to database 134 which can include a database query brokerage engine software 144 and a database management system (DBMS) 146.

User terminal 132 can provide a local user with a graphical user interface 143 to accomplish a connection to client access point 32 of network operations center 26. Database 134 can locally store information obtained from network operations center 26 regarding the user's vending machine operations. Further, the user applications and database middleware 142 can allow communication with existing legacy applications that the user may have. Further, graphical user interface 143 can be a web browser-type interface. In this case, user terminal 132 could be a computer with a web browser and

an Internet connection provided by the network interface 130.

FIGURE 6 is a functional block diagram of one embodiment of a wireless local area network implementation architecture, indicated generally at 150, according to the present invention. In architecture 150, an application host 152 is responsible for creating, maintaining and supervising a LAN on which application controllers 154, 156 and 158 reside. Application host 152 is also responsible for transmitting and receiving information to and from WAN 160. In the illustrated embodiment, WAN 160 is implemented using a two-way narrowband PCS network. It should be understood that other WAN technologies could also be used, including POTS, ADSL, ISDN, wideband PCS, circuit-switched cellular, CDPD, FrameRelay, etc. As shown in FIGURE 6, application controllers 154, 156 and 158 can act as a network node or as a network node and a relay.

In FIGURE 6, application host 152 operates to route queries directed to application controllers 152, 154 and 158 and stores vending machine data transmitted by application controllers 154, 156 and 158 on the LAN. As in the case of application controllers 154, 156 and 158, application host 152 can sit on either a wire-line(e.g. power line, Ethernet, POTS, etc.) or wireless (e.g. RF or IR) LAN using the appropriate interface and/or transceiver. If application host 152 is incapable of communicating with a specific application controller 154, 156 and 158 because of attenuation and/or noise on the network, application host 152 can request another application controller 154, 156 and 158 to route the data to/from the application controller 154, 156 and 158 which is out of range.

Creation and maintenance of the network by application host 152 can be conducted in any number of ways. One such straightforward approach is discussed below. At activation, application host 152 can transmit a broadcast signal requesting all application controllers 154, 156 and 158 to respond. Application host 152 can then build a table of application controllers 154, 156 and 158 in communication range. Application host 152 can then send a broadcast message requesting that each application controller 154, 156 and 158 in turn transmit a broadcast message requesting a response from all other application controllers 154, 156 and 158 in their communication range so each of the application controllers 154, 156, and 158 can create its own table. The information in these tables will be transmitted to application host 152. Application host 152 will then compare its initial table with all the tables sent in by the individual application controllers 154, 156 and 158. Application host 152 can then identify any application controllers 154, 156 and 158 that are not within its own primary network perimeter (communication range) and will build a routing table for application controllers 154, 156 and 158 not in communication range. This routing information will then be transmitted to each application controller 154, 156 and 158 on a relay (routing) path. From then on, data being transmitted to an application controller 154, 156 and 158 outside of application host 152's primary network perimeter will contain appropriate routing information, and vice-versa. This type of network does not preclude the possibility of any single application controller 154, 156 and 158 being totally out of network coverage but does provide for a plug-and-play network creation process for those machines within

primary and secondary network boundaries. Application controllers 154, 156 and 158 completely out of range may need to be moved to a more suitable location.

One example of multiple relay capabilities provided by the present invention is shown in FIGURE 6. By establishing a remote data acquisition and transmission system incorporating teachings of the present invention, there is no architectural limit as to the number of relays that can be implemented between the application host and any particular application controller.

In architecture 150 of FIGURE 6, application host 152 can store a copy of the firmware for application controllers 154, 156 and 158 in the event that the copy on an application controller 154, 156 and 158 becomes corrupted or needs to be updated for some reason. As with application controllers 154, 156 and 158, application host 152 can also contain special bootstrap firmware that will allow it to boot up and rewrite the contents of its own firmware. The bootstrap code will signal that application host 152 requires new firmware, and the appropriate software will be sent to it over the WAN interface. This code will then be written to the Flash memory to allow application host 152 to perform the update.

In general, the present invention provides a remote data acquisition system for monitoring and control of vending machines that includes a computer controlled application host located at vending sites. The host can include a wire-line interface or wireless transceiver through which a communication link with a remote computer can be established. The host can also include a wire-line interface and/or wireless transceiver through which the host can communicate with a plurality of vending

machines at the vending site. Each vending machine can include a microprocessor controlled set of electronics that performs the actual data acquisition functions from the vending machine and that interfaces with a wire-line interface or wireless communication transceiver for establishing a link to the vending site host computer.

In the above embodiments, an application host controls operations at each vending site. In general, the application host can be implemented by software executing on a computer system that interfaces both to the vending machines on the LAN and the external network. In one embodiment, the software will have a number of software modules or objects that perform the various functions of the application host. The application controllers can also be implemented by executing software which will have a number of software modules or objects that perform the various functions of the application controllers.

Although the present invention has been described in detail, it should be understood that various changes, substitutions and alterations can be made thereto without departing from the spirit and scope of the invention.

WHAT IS CLAIMED IS:

1. A remote data acquisition and transmission system, comprising:

a plurality of application controller, each application controller interfacing with remote equipment from which operation data is acquired by the application controller; and

an application host communicating with the application controllers via a local area network, the application host comprising a wide area network interface for communicating with a network operations center.

2. The system of Claim 1, wherein:

the local area network is supported by wireless transmissions; and

the application host and each application controller comprise a wireless LAN transceiver for communicating via the local area network.

3. The system of Claim 1, wherein:

the local area network is supported by wire-line transmissions; and

the application host and each application controller comprise a wire-line LAN transceiver for communicating via the local area network.

4. The system of Claim 1, wherein at least one of the application controllers operates as a relay for another application controller for communications to the application host.

5. The system of Claim 4, wherein the application controllers and the application host operate to autoconfigure the local area network upon initialization.

6. The system of Claim 5, wherein the autoconfiguration comprises application controllers operating as relays when necessary to establish communication between the application host and other application controllers.

7. The system of Claim 1, wherein the application host is directly connected to and associated with one of the application controllers.

8. The system of Claim 1, wherein the wide area network interface of the application host comprises a WAN wireless transceiver.

9. The system of Claim 8, wherein the WAN wireless transceiver communicates across a digital paging network.

10. The system of Claim 1, wherein the wide area network interface of the application host comprises a WAN wire-line interface.

11. The system of Claim 1, wherein each application controller interfaces with remote equipment that comprises a vending machine.

12. The system of Claim 11, wherein each application controller interfaces with the vending machine via a serial interface to a vending machine controller.

13. The system of Claim 12, wherein each application controller interfaces via a serial interface comprising a vending machine multi-drop bus.

14. The system of Claim 11, wherein the operation data acquired by each vending machine comprises product dispensing and inventory data.

15. The system of Claim 11, wherein the operation data acquired by each vending machine comprises equipment status data.

16. The system of Claim 1, further comprising a network operations center communicating with the application host via a wide area network to receive the operation data acquired by the application controllers.

17. The system of Claim 16, wherein the network operation center maintains a database storing the operation data and provides secure third party access to the database.

18. The system of Claim 17, wherein the secure third party access is provided via a web browser connecting across an internet based network.

19. A remote data acquisition and transmission system for vending machines, comprising:

a plurality of application controllers, each application controller interfacing with a vending machine controller of a vending machine from which operation data is acquired by the application controller;

an application host communicating with the application controllers via a local area network, the application host comprising a wide area network interface for communicating with a network operations center; and

the network operation center communicating with the application host via a wide area network to receive the operation data acquired by the application controllers;

the application controllers and the application host operating to autoconfigure the local area network upon initialization, the application controllers operating as relays when necessary to establish communication between the application host and other application controllers; and

the network operation center maintaining a database storing the operation data and providing third party access to the database.

20. The system of Claim 19, wherein:

the local area network is supported by wireless transmissions; and

the application host and each application controller comprise a wireless LAN transceiver for communicating via the local area network.

21. The system of Claim 19, wherein:

the local area network is supported by wire-line transmissions; and

the application host and each application controller comprise a wire-line LAN transceiver for communicating via the local area network.

22. The system of Claim 19, wherein the application host is directly connected to and associated with one of the application controllers.

23. The system of Claim 19, wherein the wide area network interface of the application host comprises a WAN wireless transceiver.

24. The system of Claim 23, wherein the wireless transceiver communicates across a digital paging network.

25. The system of Claim 19, wherein the wide area network interface of the application host comprises a WAN wire-line interface.

26. The system of Claim 19, wherein each application controller interfaces via a serial interface.

27. The system of Claim 19, wherein the operation data acquired by each vending machine comprises product dispensing and inventory data and cash levels.

28. The system of Claim 19, wherein the operation data acquired by each vending machine comprises equipment status data.

29. The system of Claim 19, wherein the third party access is provided via a web browser connecting across an internet based network.

30. The system of Claim 19 further comprising operation data communicated to each vending machine including configuration information, firmware and other information used to operate the vending machine.

31. A method for remote data acquisition and transmission, comprising:

interfacing at least one of application controller with remote equipment from which operation data is acquired by the application controller;

communicating between an application host and each application controllers; and

communicating between the application host and a network operations center using a wide area network interface.

32. The method of Claim 31 further comprising:

interfacing at least two of the application controllers with respective remote equipment; and

communicating between the application host and the application controllers via a local area network.

33. The method of Claim 32, wherein communicating via the local area network is supported by wireless transmissions using wireless LAN transceivers.

34. The method of Claim 33, wherein communicating via the local area network is supported by transmissions over a wire-line interface using wire-line LAN transceivers.

35. The method of Claim 34, further comprising operating at least one of the application controllers as a relay for another application controller for communications to the application host.

36. The method of Claim 35, further comprising autoconfiguring the local area network upon initialization.

37. The method of Claim 36, wherein the autoconfiguring comprises application controllers operating as relays when necessary to establish communication between the application host and other application controllers.

38. The method of Claim 31, further comprising directly connecting the application host with at least one of the application controllers.

39. The method of Claim 31, wherein communicating between the application host and a network operations center uses a wide area network interface comprising a WAN wireless transceiver.

40. The method of Claim 39, wherein the WAN wireless transceiver communicates across a digital paging network.

41. The method of Claim 31, wherein communicating between the application host and a network operations center uses a wide area network interface comprising a WAN wire-line interface.

42. The method of Claim 31, wherein each application controller interfaces with remote equipment that comprises a vending machine.

43. The method of Claim 42, wherein each application controller interfaces with the vending machine via a serial interface to a vending machine controller.

44. The method of Claim 32 further comprising communicating firmware from the network operations center to the application host.

45. The method of Claim 43 further comprising communicating the firmware from the application host to the application controller.

46. The method of Claim 31, further comprising communicating between a network operation center and the application host via a wide area network to receive the operation data acquired by the application controllers.

47. The method of Claim 46, further comprising, at the network operation center, maintaining a database storing the operation data and providing secure third party access to the database.

48. The method of Claim 47, wherein the secure third party access is provided via a web browser connecting across an internet based network.

49. An application controller for use as part of a remote data acquisition and transmission system, the controller comprising:

a microprocessor connected with a memory unit;

a number of sensors to acquire data and a serial interface connected with the microprocessor to provide data thereto from the sensors;

a hardware interface bus for providing information to the microprocessor from other components of the system;

a radio frequency identification transceiver for remote identification of an inventory of products; and

a power supply.

50. The application controller of Claim 49 further comprising a wireless LAN transceiver for communicating over a local area network via wireless transmissions.

51. The application controller of Claim 49 further comprising a wire-line LAN transceiver for communicating over a local area network via wire-line transmissions.

52. The application controller of Claim 49 wherein the power supply further comprises a battery backup.

53. The application controller of Claim 49 further comprising a heater connected with the power supply.

54. The application controller of Claim 49 further comprising an electronic lock driver coupled with the microprocessor to communicate with an electronic lock.

55. The application controller of Claim 49 further comprising an application host having:

a microprocessor connected with a memory unit;

a mass data storage device connected to the microprocessor; and

a hardware interface bus for providing information to the microprocessor from other components of the system.

56. The application controller of Claim 55 further comprising a direct connection via the hardware interface bus with the application host.

57. The application controller of Claim 55 further comprising a WAN transceiver forming a portion of the application host.

58. An application controller for use as part of a remote data acquisition and transmission system for a vending machine, the controller comprising:

a microprocessor connected with a memory unit;

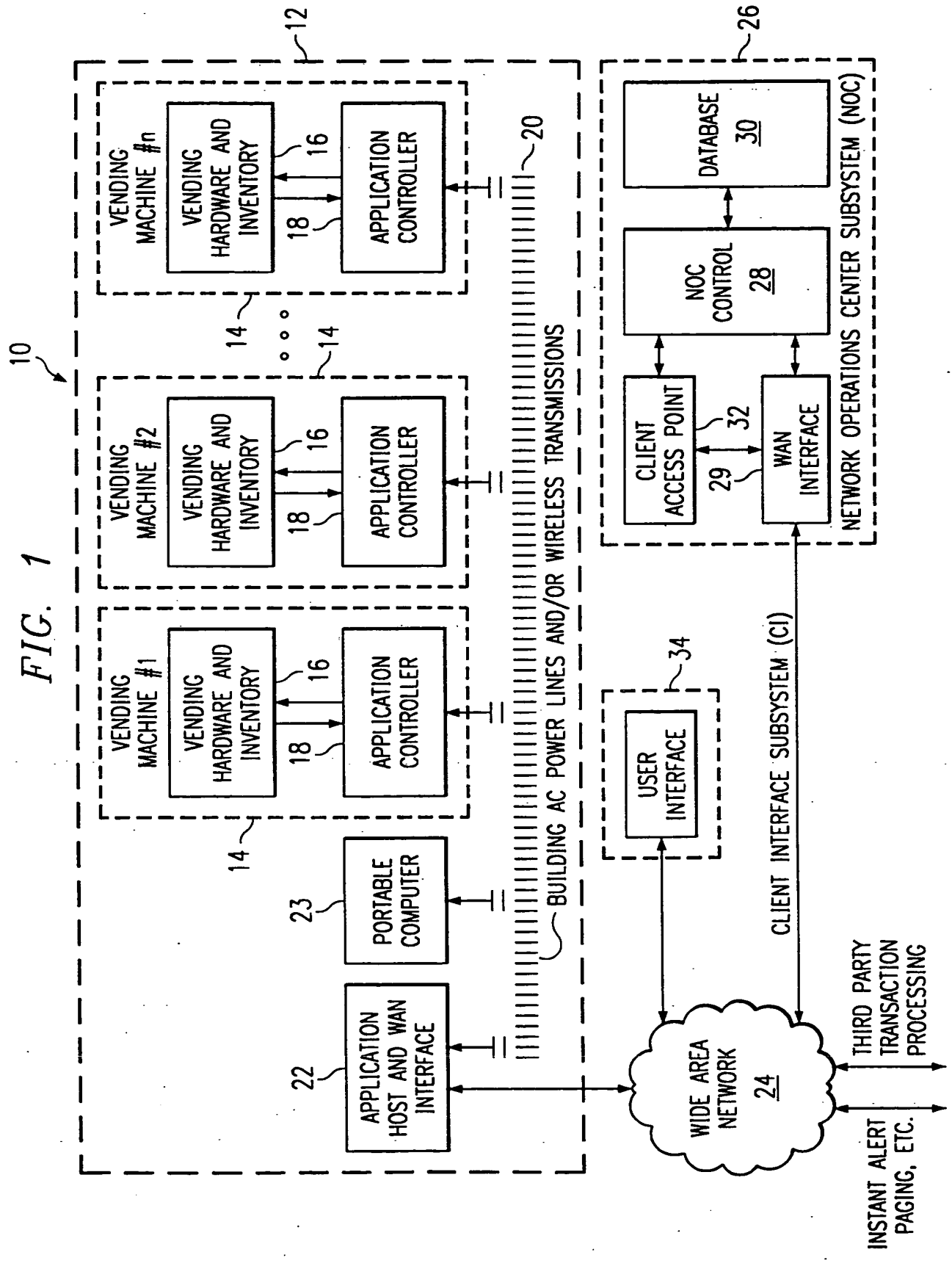
a number of sensors to acquire data and a serial interface connected with the microprocessor to provide data thereto from the sensors;

a hardware interface bus for providing information to the microprocessor from other components of the system;

a LAN transceiver for communicating over a local area network; and

a power supply.

FIG. 1



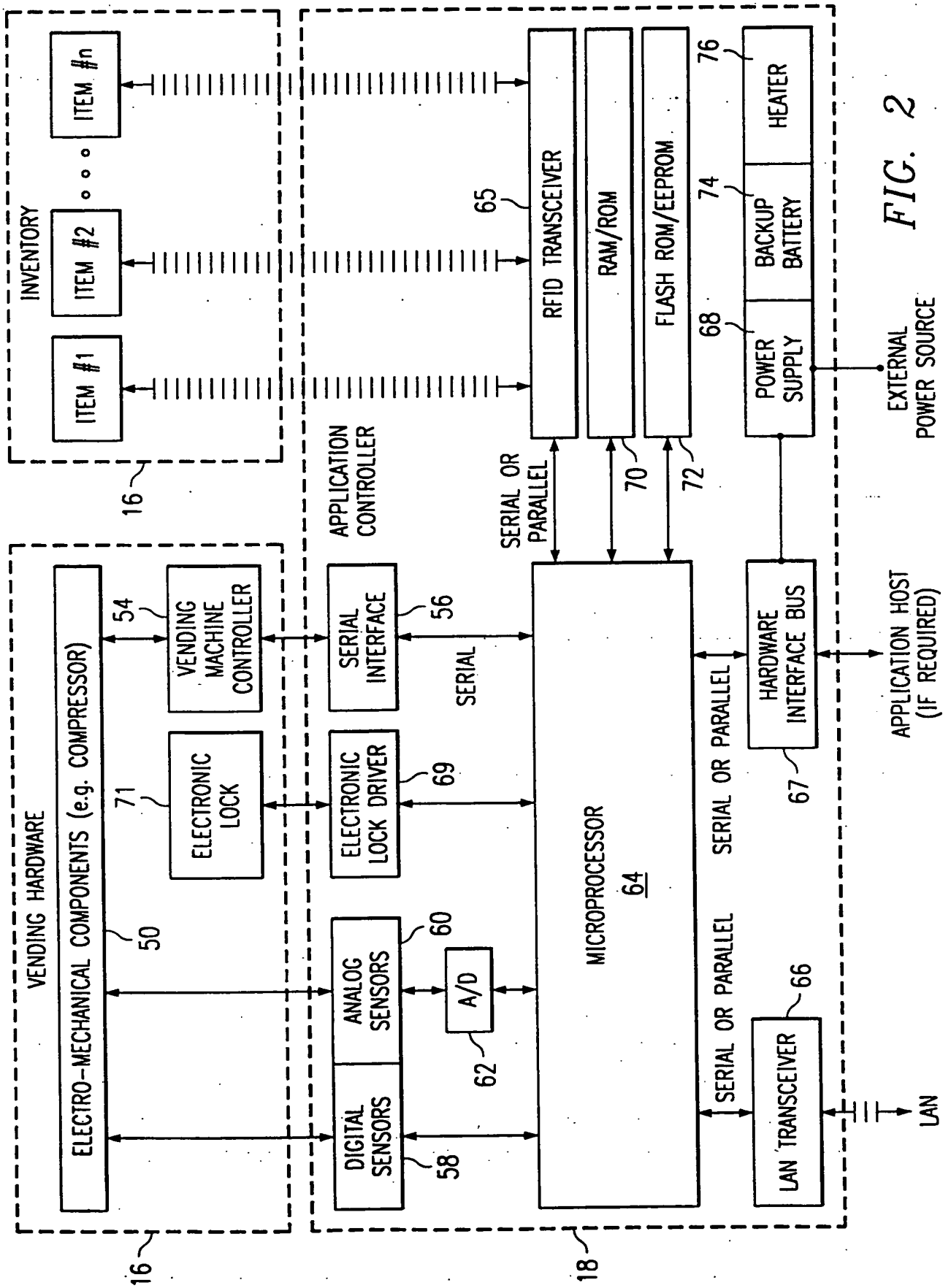

INVENTORY
ITEM #1
ITEM #2
ITEM #n
16
APPLICATION CONTROLLER
RFID TRANSCEIVER
65
RAM/ROM
FLASH ROM/EEPROM
72
70
HEATER
76
BACKUP BATTERY
74
POWER SUPPLY
68
EXTERNAL POWER SOURCE
SERIAL OR PARALLEL
VENDING HARDWARE
ELECTRO-MECHANICAL COMPONENTS (e.g. COMPRESSOR)
50
VENDING MACHINE CONTROLLER
54
SERIAL INTERFACE
56
SERIAL
ELECTRONIC LOCK
71
ELECTRONIC LOCK DRIVER
69
ANALOG SENSORS
60
A/D
62
DIGITAL SENSORS
58
MICROPROCESSOR
64
SERIAL OR PARALLEL
HARDWARE INTERFACE BUS
67
APPLICATION HOST (IF REQUIRED)
LAN TRANSCEIVER
66
LAN
18

FIG. 2

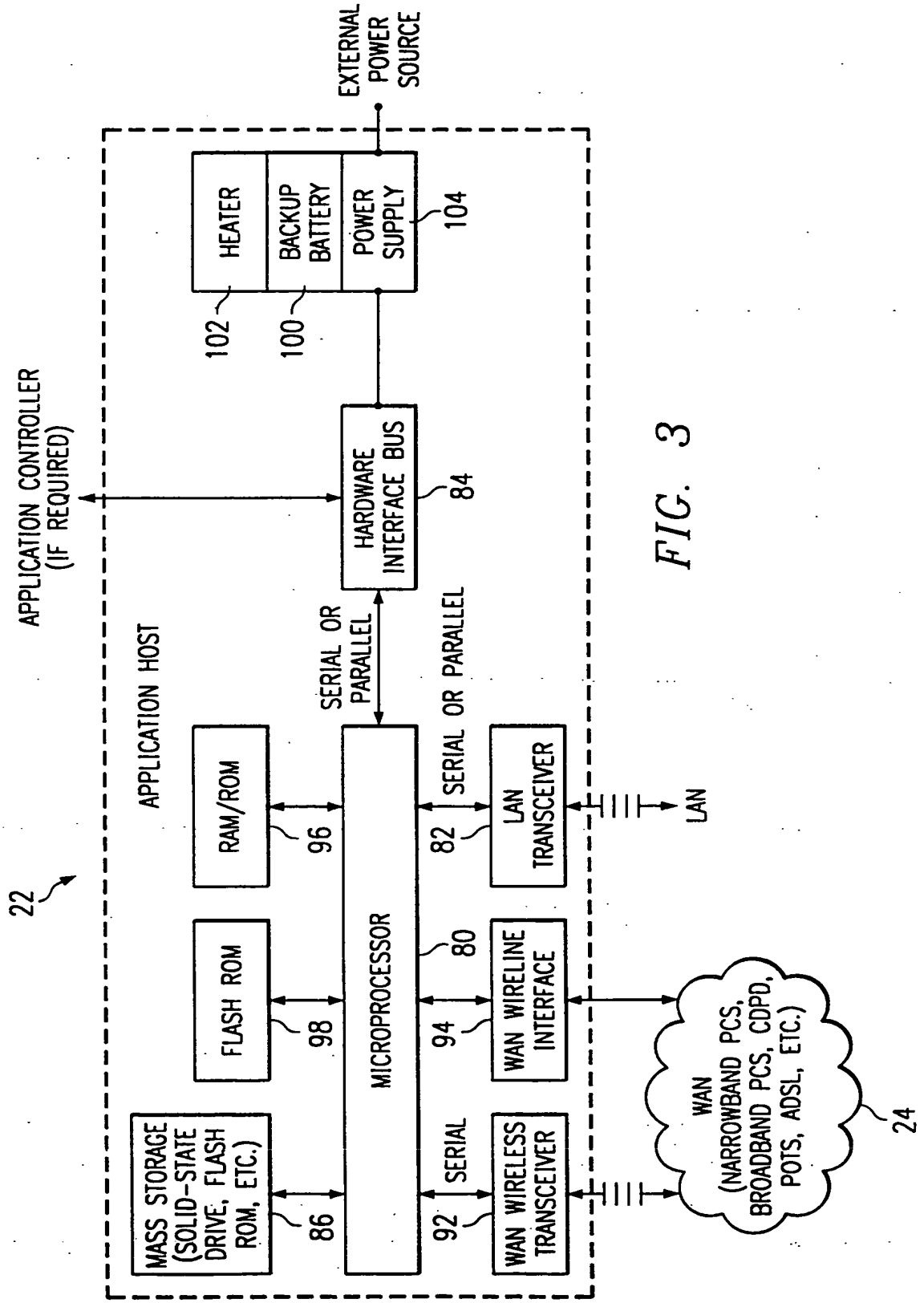

EXTERNAL POWER SOURCE
HEATER
BACKUP BATTERY
POWER SUPPLY
104
102
100
APPLICATION CONTROLLER (IF REQUIRED)
HARDWARE INTERFACE BUS
84
APPLICATION HOST
SERIAL OR PARALLEL
SERIAL OR PARALLEL
RAM/ROM
96
LAN TRANSCEIVER
82
LAN
22
FLASH ROM
98
MICROPROCESSOR
80
WAN WIRELINE INTERFACE
94
MASS STORAGE (SOLID-STATE DRIVE, FLASH ROM, ETC.)
86
SERIAL
92
WAN WIRELESS TRANSCEIVER
WAN (NARROWBAND PCS, BROADBAND PCS, CDPD, POTS, ADSL, ETC.)
24

FIG. 3

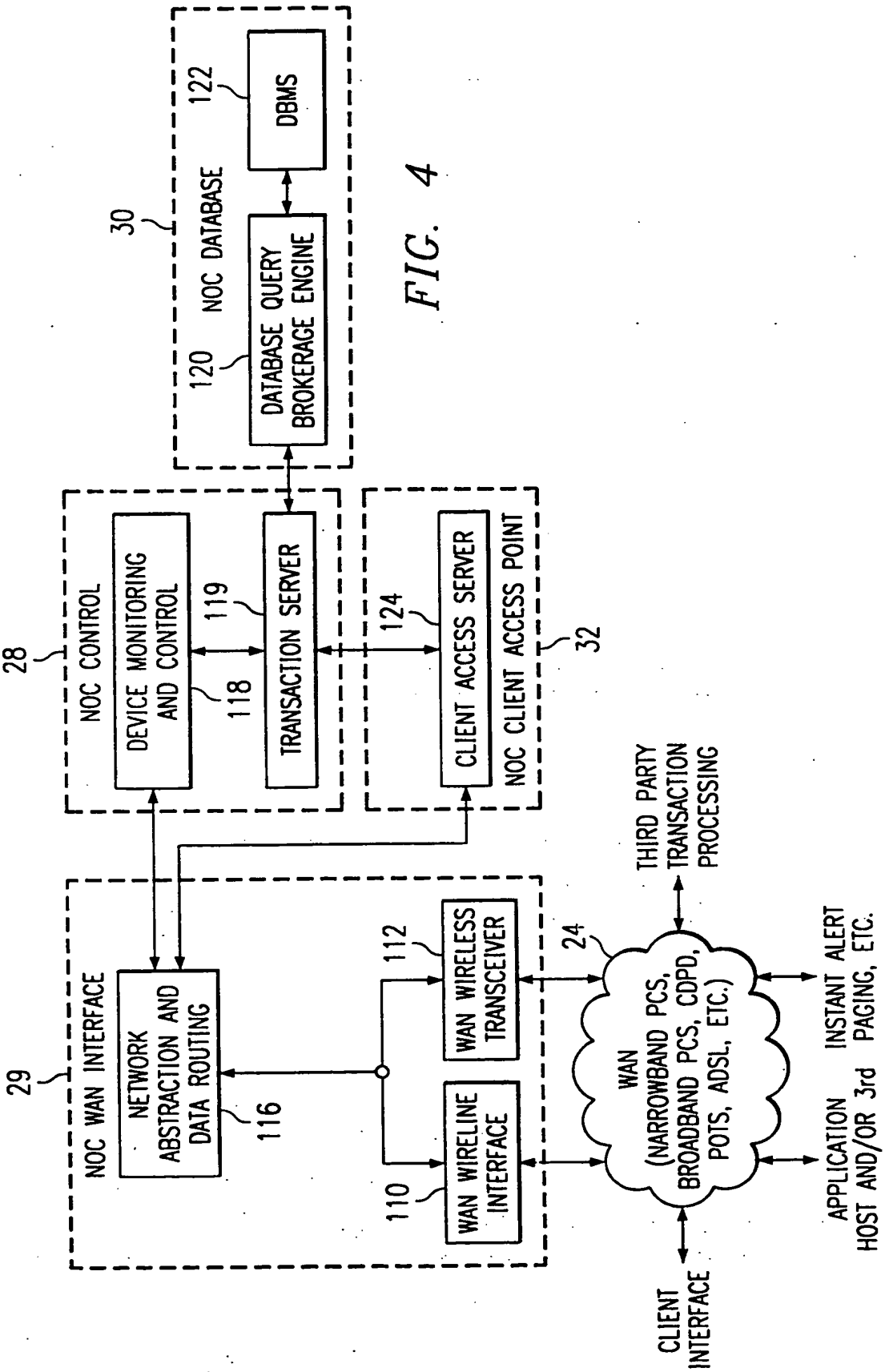


FIG. 4

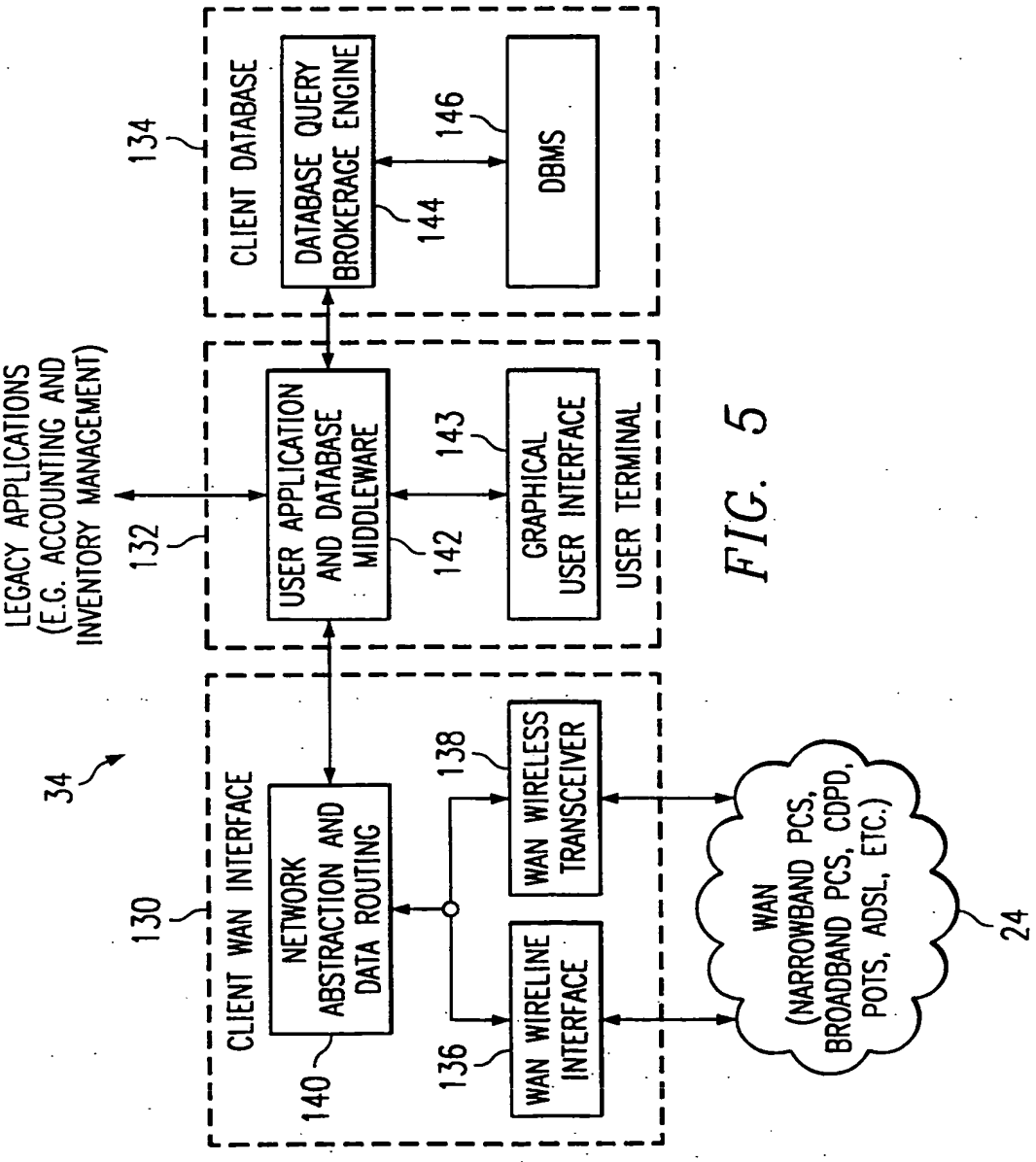
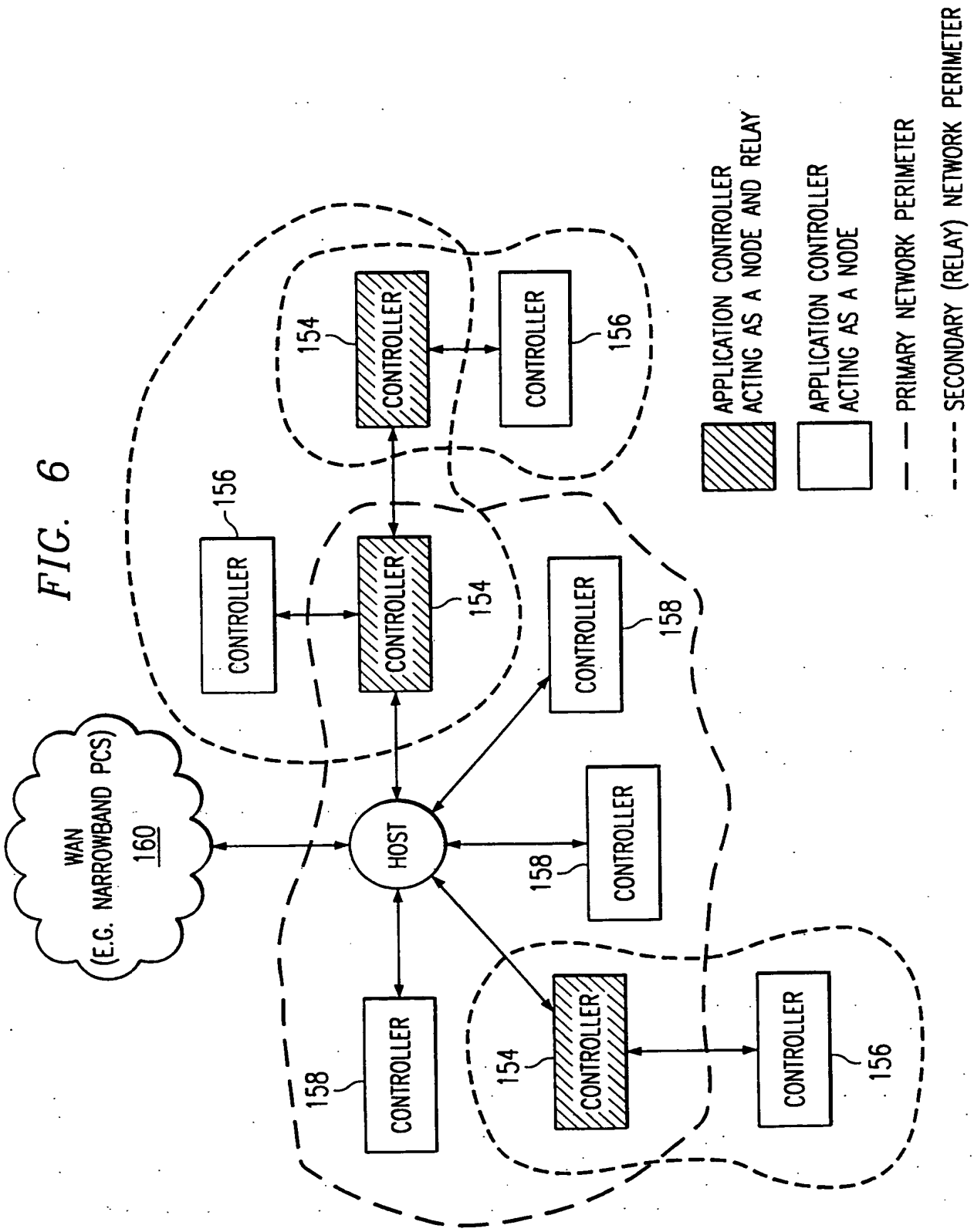


FIG. 5

FIG. 6


WAN
(E.G. NARROWBAND PCS)
160
HOST
CONTROLLER
154
156
158
APPLICATION CONTROLLER ACTING AS A NODE AND RELAY
APPLICATION CONTROLLER ACTING AS A NODE
PRIMARY NETWORK PERIMETER
SECONDARY (RELAY) NETWORK PERIMETER

INTERNATIONAL SEARCH REPORT

Inte .ional Application No
PCT/US 99/05983

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G07F9/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 G07F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 95 04333 A (FRAU PAOLA ;FACCHIN DANIELA (IT)) 9 February 1995 (1995-02-09)	1-4,7,8, 10,11, 14, 16-18, 31-35, 38,39, 41,42, 44-48,58
Y	page 1, line 1 - line 10	5,6,9, 12,13, 15, 19-30, 36,37, 40,43,57
A	page 2, line 11 - line 31 page 3, line 13 - line 17 page 3, line 21 - line 23 page 3, line 26 - page 4, line 35 page 7, line 4 - line 20	49-56

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
6 August 1999	13/08/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Wauters, J

2

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Inte. .onal Application No
PCT/US 99/05983

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
	page 7, line 35 - page 8, line 4 page 8, line 22 - page 9, line 5; claims 1,4; figures 1,2	
X Y	US 4 412 292 A (SEDAM JASON K ET AL) 25 October 1983 (1983-10-25) column 2, line 16 - line 38	49-51, 55,56,58 5,6, 19-30, 36,37, 43, 52-54,57
A	column 2, line 44 - line 58 column 2, line 65 - column 3, line 22 column 3, line 37 - line 44 column 4, line 53 - column 5, line 35 column 7, line 46 - line 50; figures 1,2	1-4, 7-18, 31-35, 38-42, 44,48
X Y	WO 95 05609 A (REAL TIME DATA) 23 February 1995 (1995-02-23) page 4, line 1 - line 29	49-51,58 9,12,13, 15,40, 52,53
A	page 8, line 6 - line 16 page 22, line 25 - page 23, line 3 page 24, line 17 - line 19 page 26, line 5 - line 7; claims 1-3,9,10,13; figures 1-5,1,1	1-8,10, 11,14, 16-39, 41-48, 54-57
Y A	US 5 339 250 A (DURBIN MARTIN J) 16 August 1994 (1994-08-16) column 5, line 42 - line 55; claim 1; figures 1,2	54 1-53, 55-58
A	EP 0 817 138 A (SANYO ELECTRIC CO) 7 January 1998 (1998-01-07)	
A	US 5 091 713 A (HORNE ARTHUR H ET AL) 25 February 1992 (1992-02-25)	
A	FR 2 744 545 A (PEUDEPIECE GERARD) 8 August 1997 (1997-08-08)	
A	US 5 207 784 A (SCHWARTZENDRUBER WILBUR) 4 May 1993 (1993-05-04)	

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

Inte. ional Application No
PCT/US 99/05983

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9504333 A	09-02-1995	IT VI930134 A	02-02-1995
		AT 160040 T	15-11-1997
		AU 686224 B	05-02-1998
		AU 7610494 A	28-02-1995
		BR 9407166 A	17-09-1996
		CA 2168476 A	09-02-1995
		CN 1128075 A	31-07-1996
		DE 69406670 D	11-12-1997
		DE 69406670 T	04-06-1998
		EP 0716763 A	19-06-1996
		ES 2110773 T	16-02-1998
		GR 3026085 T	29-05-1998
		US 5701252 A	23-12-1997
US 4412292 A	25-10-1983	AU 561884 B	21-05-1987
		AU 5766286 A	06-11-1986
		AU 561947 B	21-05-1987
		AU 5766386 A	06-11-1986
		AU 551692 B	08-05-1986
		AU 8034582 A	26-08-1982
		CA 1166356 A	24-04-1984
		DE 3205620 A	16-09-1982
		IT 1149761 B	10-12-1986
		JP 1726468 C	19-01-1993
		JP 4001392 B	10-01-1992
		JP 57155685 A	25-09-1982
WO 9505609 A	23-02-1995	AU 7562794 A	14-03-1995
		CA 2169761 A	23-02-1995
		EP 0716749 A	19-06-1996
		JP 9507593 T	29-07-1997
US 5339250 A	16-08-1994	AU 655424 B	22-12-1994
		AU 8050391 A	07-01-1992
		CA 2083850 A	16-12-1991
		EP 0533800 A	31-03-1993
		WO 9120046 A	26-12-1991
EP 0817138 A	07-01-1998	WO 9724701 A	10-07-1997
US 5091713 A	25-02-1992	NONE	
FR 2744545 A	08-08-1997	NONE	
US 5207784 A	04-05-1993	NONE	